ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 17 No. 1 March 2017 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2017; **17(1):** 11673-11690 **DOI: 10.18697/ajfand.77.16560**

SUSTAINABLE AGRICULTURE: DEVELOPING A COMMON UNDERSTANDING FOR MODERNIZATION OF AGRICULTURE IN AFRICA

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ABSTRACT

The concept of sustainability has become central to all sectors all over the world, from agriculture to environment to business, engineering and industrialization. The principle of sustainability is the same all over these sectors. However, the understanding of the term may vary from sector to sector depending on how it may be applied to a specific sector. Sustainable agriculture is a term that continues to gain prominence in the agricultural sector but not without lots of misunderstanding, controversy and challenges. It is necessary that the sector has a common understanding of this term if it has to be applied by all and sundry. This is more so today due to the heightened importance of sustainable agriculture following its elevation to a key target in Sustainable Development Goal No. 2. This paper has been necessitated by the need to address the divergent perceptions of sustainable agriculture, which make it difficult to universally apply the concept in the agricultural sector and which could adversely affect the attainment of the goal's target. Sustainable agriculture has been wrongly linked to a return to either the low yields or poor farmers that characterized the 19th century and the use of low value labour-intensive agricultural resources and production systems. It has also been viewed as an attack on conventional agriculture and intended for use by resource- poor farmers. With these perceptions, a common way forward towards sustainable agriculture is not possible. The paper highlights the varied but related definitions of sustainable agriculture and suggests that because of the "boundary object" nature of the definition, the principles of sustainable agriculture should provide a good guide to be followed in pursuit of the same. The paper suggests possible reasons why sustainable agriculture concept is not widely applied in Africa and proposes important actions to be undertaken to enhance wider application of this concept in agricultural systems.

Key words: Agriculture, sustainable intensification, sustainable agriculture, sustainability, agricultural systems, sustainable development

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INTRODUCTION

The use of the term "sustainable agriculture" (SA) has been around for some time now, and many will rightly define it as production for today without compromising the ability of the future generations to do the same. They will also enumerate the key components of sustainable agriculture as socially acceptable, economically viable and environmentally sound. But to what extend is this concept applied in agricultural production? In agriculture, the concept has been dogged with misunderstandings to the extent that most mainstream agricultural extension services in Africa have not given it the prominence that it deserves. Worse still, the formal education has not strived to empower the upcoming generations with adequate knowledge to enable them apply this concept in future. This is a remarkable contrast to the position in the developed countries where the concept is fairly developed and even included in the mainstream agricultural policies and education systems. In the United States for example, the United States Department of Agriculture (USDA) runs several sustainable agriculture programmes including trainings, research and funding for the same.

The need to feed growing populations cannot be overemphasized. The current most critical agricultural challenges are threefold. First is provision of food to satisfy the demand from the ever increasing population. It is estimated that the world will need to produce 70% more food in 2050 than what is being produced today [1]. This demand is also growing in terms of diversity and sophistication. Where people simply ate sorghum, there come demands for low tannin sorghum, high nutrient sorghum and colour of preference. This complicates the production since these demands have to be met in one variety. Related to this is the challenge of constantly increasing yields on fixed areas of land. The world's production area is fixed, with no new land to open for most countries. Even where there is previously unused land it is just a matter of time before such land is exhausted. This pushes production to marginal lands, where it has been shown that cultivation is likely to make them delicate and result in adverse effects on the environment such as erosion and nutrient run-off. Then there is the decline in productivity of land. All across Africa, the story is the same. Farmers tell of soils that used to be highly productive now barely producing anything significant. In an attempt to boost production of such lands, farmers have used more and more fertilizers only to realize degradation in the physical and chemical properties of soils leading to the yields diminishing even more. The farmers hence end up using more capital to produce less.

The second challenge relates to alleviation of poverty among the poor who are the majority of Africa's population. It is estimated that about 42% of the population in Sub-Saharan Africa live on less than one dollar per day and that although progress has been made globally in reducing poverty, with global poverty projected to have fallen below 10% for the first time in 2015, sub-Saharan Africa has made insignificant progress, improving only by 28% over the last 25 years (Figure 1) [2]. According to the World Bank, about 70% of the sub-Saharan African population is engaged in agriculture [3]. This implies that for this region any meaningful improvement in income levels will be determined largely by agriculture. Unfortunately, poverty levels have not shown any significant improvement over the past years despite the many interventions being made in that line.

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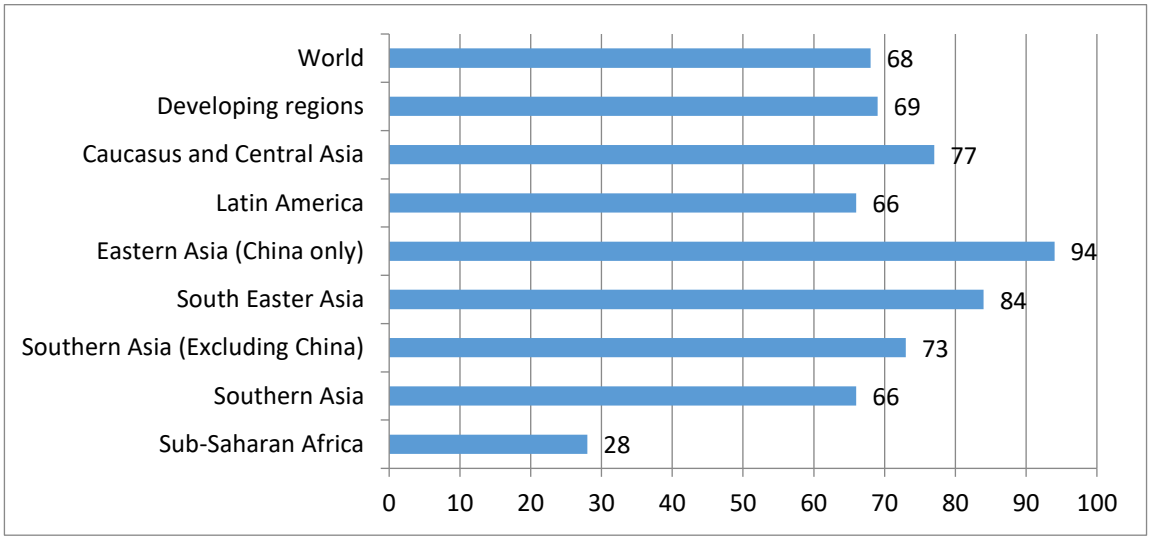

Figure 1: Reduction in proportion of people living on less than 1.25 dollars per day between 1990 and 2015 (Source: United Nations Millennium Development Goals status report, 2015)

The third challenge stems from adverse effects posed by climate change. With global warming, the productive land is diminishing at a faster rate than anticipated. The desert area is increasing at a rate of 12 million ha/year (23ha/minute). The temperature is rising, the highest average temperature ever recorded was in 2015, being 0.9°C above the 19th century benchmark and 2016 has been predicted to surpass that mark [4]. Utilization of many of the previously preferred crop varieties are diminishing, many new problematic weed plants are emerging and so are pests and diseases.

To overcome these challenges calls for a new and all-inclusive approach. Mankind has started appreciating the need to cooperate in a bid to address their challenges. All activities and actions are interlinked in one way or another. There is, therefore, need for agriculturalists to have a common understanding of how all activities undertaken by them influence other activities within their set up and beyond as well as how activities of others influence their own activities. Sustainable agriculture tends to consider agricultural production as a system, encompassing all the social, economic and environmental aspects of production. To embrace sustainable agriculture by all players, a sound understanding of principles underlying this concept needs to be enhanced.

HISTORY AND DEFINITIONS OF SUSTAINABLE AGRICULTURE

The term Sustainable agriculture was first encountered in the proceedings of an international conference of the International Federation of Organic Agriculture Movements (IFOAM) as early as 1976 [5]. Possibly this may explain the common linking of sustainable agriculture to organic agriculture and its various approaches by many people. The term sustainable is an adjective of sustain whose origin is Latin "sustinere" meaning to keep in existence or to maintain. Based on the common

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understanding of this term, it is probably more important to understand sustainable agriculture from the context of what it is not.

Sustainable agriculture is not organic farming or organic agriculture. The latter is an important ingredient of sustainable agriculture among many others. Sustainable agriculture is not a method of agricultural production nor does it refer to a prescribed set of practices. Sustainable agriculture does not refer to the use of labour- intensive, low cost input and low technology methods. It does not mean farming without application of synthetic chemicals and fertilizers. Sustainable agriculture does not mean low external input farming nor is it conservation agriculture. According to the National Academy of Sciences, "the idea of agricultural sustainability does not mean ruling out technologies or practices on ideological grounds if they can improve productivity and do not significantly affect the other objectives of sustainability" [6].

So then, what is sustainable agriculture? There may be no universal definition of sustainable agriculture but some key principles remain common for anybody attempting to describe it. Several definitions have been fronted, but only a few are highlighted here. The American Society of Agronomy defined sustainable agriculture as a system that, "over the long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fibre needs; is economically viable; and enhances the quality of life for farmers and society as a whole" [7]. In the 1990 US Farm Bill, sustainable agriculture was defined as "meeting human food and fiber needs, sustaining the economic viability of farms, enhancing the quality of life for farmers and society, enhancing environmental quality, and efficiently using nonrenewable resources" [8]. Francis and Youngberg describe sustainable agriculture as a philosophy based on human goals and on understanding the long-term impact of our activities on the environment and on other species [9]. Yet non-governmental organization (NGO) Sustainable Agriculture Treaty make several assertions about sustainable agriculture but in principle state that agriculture is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate and based on a holistic scientific approach [10].

According to USDA, sustainable agriculture is "a way of practicing agriculture which seeks to optimize skills and technology to achieve long-term stability of the agricultural enterprise, environmental protection, and consumer safety" [11]. Pretty attempted to give a working definition as "the development and use of agricultural technology and practices that do not have adverse effects on the environment, are accessible to and effective for farmers, lead to improvements in food productivity and have positive side effects on environmental goods and services" [12].

Needless to say, these definitions and their variations are unending. In fact, the term has been referred to as a "boundary object" in reference to the description of a boundary object as a concept or idea whose meaning is understood by everybody even though such meaning is not the same for everyone [13, 14]. Benbrook concluded that the community had reached about as explicit, useful, concrete a definition of sustainable agriculture for now in view of the differences of opinion and views that existed and that such a definition would end up being a compromise among differing world views and

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values [15]. In other words, what is common in the definitions highlighted should be sufficient to guide all towards the right general direction without striving to have a standard definition.

This leaves us with the need to understand the principles of sustainable agriculture as the most appropriate approach towards defining it. According to Sustainable Agriculture Research and Extension (SARE), there are three underlying pillars with regard to sustainable agriculture [16]. These are stewardship of natural resources, profitability of farm business and quality of life, as illustrated below (Figure 2).

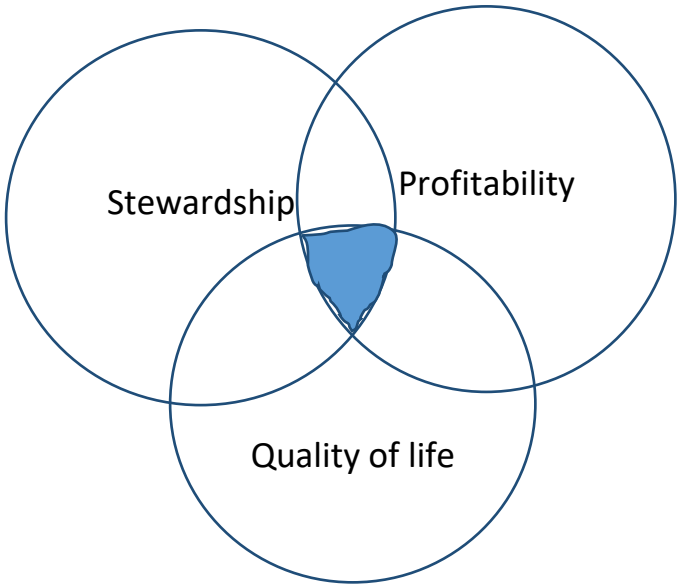

Figure 2: Illustration of the relationship between the three pillars of sustainable agriculture

The sustainability target is the intersection of the three pillars; this is where all the three are demonstrated equally and simultaneously. According to Gold, sustainable agriculture does not refer to a prescribed set of practices but it instead challenges producers to think about the long-term implications of practices and the broad interactions and dynamics of agricultural systems [5]. To better understand agricultural sustainability, a systems approach is inevitable. Sustainable Agriculture Research and Extension Programme (SAREP) describes the system broadly as ranging from the individual farm, to the local ecosystem, and to communities affected by this farming system both locally and globally [17].

WHY SUSTAINABLE AGRICULTURE IS IMPORTANT

What are the ecological, economic, social and philosophical issues that sustainable agriculture wishes to address? In other words, what has made sustainable agriculture important at this point in time? The prevailing agricultural systems, widely referred to

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as conventional, industrial or modern agriculture, have achieved tremendous success in feeding the world to date. Conventional agriculture is characterized by rapid technological innovation, large capital investments, large-scale farms, mono-cropping, uniform and high yielding hybrid crops and varieties, extensive use of pesticides, fertilizers, and external energy inputs, intensive and confined production systems for livestock, high labour efficiency and dependency on agribusiness. In fact, 70-90% of the increase in food could be attributed more to technological advancement in conventional agriculture than to increase in acreage [4]. Out of this prosperity of modern agriculture, several concerns were raised. Some of these concerns are highlighted below:

Decline in productivity of land

Many factors may lead to a decline in productivity. Conventional agriculture depends on tillage and cultivation, which unless properly done may lead to water and wind erosion resulting in loss of plant nutrients, organic matter and minerals. This may lead to other soil related problems like compaction, salinization and loss of water holding capacity and biological activity. In some areas there is also overgrazing resulting in similar problems. Mono-cropping on the other hand depletes nutrients at one level of the soil and leads to accumulation of pests and diseases.

Environmental concerns

Intensive cultivation has been found to be associated with water pollutants such as sediments, fertilizers (nitrates and phosphorus) and pesticides. Spills from manure lagoons on hog farms and phosphorus from chicken litter are examples of such pollutants. Eutrophication from nutrient runoff affects many rivers, lakes, and oceans. Reports of pesticide residues in foods started emerging in 1980s and have seriously influenced production and marketing of foods and other agricultural produce.

Socio - Economic concerns

Agriculture plays a key role in poverty alleviation especially for rural households. Challenges to this noble cause have continued to emerge. There are increasing incidences of very sharp contrasts between scarcity and plenty of food and agricultural produce, a socially unacceptable state. Farmers have little control over farm prices, and they continue to receive a smaller and smaller proportion of income earned from agricultural produce while the non-farm participants carry away the largest proportion. In most African countries, the so called “middle men” suck most of the earnings while in developed countries, emergence of large commercial farms and greater cooperate control of agricultural production has continued to push family farms to the periphery. At the same time there is disintegration of the rural life and communal associations that existed before.

Agricultural energy concerns

Agriculture requires energy for most of its operations. It was realized in the 1970s that the supply of fossil fuel was fragile and could not be sustained. This means that for purposes of sustaining productivity in the future, sustainable renewable sources of energy need to be embraced.

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Effects of climate change

More recently, the adverse effects of climate change on agricultural production have become a source of worry for the world with agriculture contributing significantly to greenhouse gasses emissions. It is also felt that with proper interventions, agriculture could do more for climate change adaptation and mitigation.

Based on the above concerns, alternative agricultural approaches that concerned themselves with addressing these challenges were developed. Sustainable agriculture supports intensified production of food to meet the future demand from the growing population especially with the consideration of the fact that natural resources on which agriculture depends are becoming scarce. To secure the livelihoods of rural populations with decent income and quality of life, it will be important to embrace sustainable agricultural systems that will be viable in the long term.

PRINCIPLES OF SUSTAINABLE AGRICULTURE

In line with the above descriptions and definitions, it is important to enhance the understanding of sustainable agriculture by reviewing its key principles as described below.

(1) **Improvement of the quality of life**: Agriculture has intrinsic value on rural life and livelihoods. The life of individuals and communities needs to be improved through the various interventions of sustainable agriculture with clear consideration that farmers play a key role as producers of food for the society.

(2) **A system approach:** Sustainable agriculture involves considering interactions and interrelations of a system as a whole, from individual farms, to local ecosystems to communities affected by the farming system both locally and internationally.

(3) Profitability: The focus of sustainable agriculture is not on maximization of yields, but rather on development of farm businesses that are profitable in the long run. The SARE summarizes this by stating that systems and practices that do not include profitability as one of the prime motivators cannot be voluntarily implemented [16].

(4) **Stewardship:** Sustainable agriculture should nurture the role of farmers as stewards or custodians of the land and natural resources. This fosters prudent use of renewable and/or recyclable resources as well as protection of the integrity of natural systems so that natural resources are capable of continual regeneration. In fact, a sustainable agricultural system considers the long-term good of all members of the land community.

(5) Equal emphasis on science and experience: In excerpts from *NGO Sustainable Agriculture Treaty***,** sustainable agriculture uses the insights of modern science to improve rather than displace the traditional wisdom accumulated over centuries

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by farmers around the world [10]. Because sustainable agriculture relies on scientific principles to apply established facts and to establish new ones, research remains central in the whole process of attaining sustainability.

(6) Multidisciplinary nature: Sustainable agriculture relies on knowledge from virtually all disciplines. The complex interactions between crops, animals, microorganisms and the environment require knowledge of scientists from a variety of disciplines in the natural sciences. The profitability component brings in economics, business and marketing while the social component requires sociology, psychology and community studies. Since sustainable agriculture is at the heart of food production, the components of nutrition, health and medicine also become very important.

(7) The transition to sustainable agriculture is a process: As stated earlier, sustainable agriculture is an ultimate goal. Every right action taken by each person is one little step towards attainment of this goal. The transition to sustainable agriculture is, therefore, a process; farmers taking a series of small but realistic steps towards it. The rate of transition is determined by many factors including the economic status of the households and their personal goals.

SUSTAINABLE AGRICULTURE AND MODERN FARMING: THE MISSING LINK

One would be left to wonder then why this important concept has not been embraced by all. As posed in a SARE publication, would anybody wish to undertake agriculture that is unsustainable [16]? For those involved in modern agricultural production then the question would be, is it possible to practice sustainable agriculture in modern farming? The missing link between modern agriculture and sustainable agriculture in Africa today has more to do with perception. To understand this gap one must attempt to understand the history of agriculture in Africa.

In many parts of Africa, modernization of agriculture was fronted by colonialists back in the 19th century, with emphasis on increasing production using modern technology. This approach was taken up by African governments and advanced until today. The sustainable agriculture concept was mooted later on in developed countries in response to the challenges posed by conventional agriculture highlighted above. It, therefore, had to be introduced in Africa by non-governmental organizations working side by side with the mainstream governments to improve the livelihoods of mostly resource poor peasants. As a result, sustainable agriculture was perceived in two ways: one as a contrast to the mainstream agriculture promoted by government extension services and second as a practice for the poor farmers unable to engage in conventional agriculture. This perception has remained largely so until today as evidenced by the following descriptions:

Sustainable Agriculture is, or has until recently, not been recognized by the mainstream government extension services in most African countries. Its promotion remains largely with NGOs with the funding of development partners making it appear like a preserve

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of these NGOs and creating some sort of competition or contest between the mainstream agricultural extension and the supplementary extension services. In a study by the International Institute for Environment and Development (IIED), it was reported that in Kenya, Senegal and Pakistan, sustainable agriculture dwelt on linkages between external institutions, that is, change agents especially NGOs, and grassroots operating in unfavorable policy environment [18]. The report also noted that service delivery by the national government in Kenya would be very biased and occasionally hostile against sustainable agriculture. This rift is worsened by the fact that the NGOs are not best placed to promote sustainable agriculture as a concept in view of its broad nature and so they take up certain practices that they find convenient to promote. This has largely contributed to the erroneous understanding of sustainable agriculture as a set of prescribed practices. Secondly, most NGOs come up with projects, which are short term hence inappropriate to advance the broad long term goal of sustainable agriculture [6]. And thirdly, many NGOs engage personnel with lower qualifications and experience than the government extension agents. This invites criticisms from the government agencies with regard to quality and accuracy of extension messages being promoted.

In the formal agricultural training systems, the concept of sustainable agriculture is missing (or has been missing). Again training in sustainable agriculture has been left to the non-formal education systems mostly supported by NGOs. In Kenya for example, no public university offers an undergraduate degree in sustainable agriculture. A review of agriculture curricula offered at these universities also reveals that sustainable agriculture is either completely missing or is only mentioned in passing as one of the alternative "methods" to conventional agriculture. We now start to understand why the situation is not likely to change any time soon unless deliberate interventions are made at formal educational and government institutions.

A quick contrast with the developed countries may help us point towards the right direction. Most governments of developed countries have very strong components of sustainable agriculture in their comprehensive agriculture plans. The US Department of Agriculture declared to balance goals of improved production and profitability, stewardship of the natural resource base and ecological systems, and enhancement of the vitality of rural communities as far back as 1996. The USDA has a strong sustainable agriculture component including sponsorship of Sustainable Agriculture Research and Extension (SARE) and a comprehensive sustainable agriculture policy developed many years ago. In the US, very many universities have elaborate sustainable agriculture academic programmes emphasizing the concept. The USAID has a long list of sustainable agriculture programmes, some being implemented widely in Africa.

In Europe, at the core of the European Union Development Policy is the investment in sustainable and inclusive agriculture and the development of supportive policies both for the developed as well as the developing countries. The common agricultural policy is developed with a view to helping agriculture respond to the needs of sustainable development. The European Union (EU) is an important actor in promoting sustainable agriculture on the international development agenda and advocates an economically, ecologically and socially sustainable agriculture in its development cooperation policy

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[19]. The EU development agenda recognizes the central role of agriculture and food security in fostering inclusive and sustainable growth and focuses support to sustainable practices such as safeguarding ecosystem services, giving priority to locally-developed practices, smallholder agriculture and rural livelihoods, setting up of producer groups, and addressing the supply and marketing chain, as well as responsible private investment.

THE WAY FORWARD FOR SUSTAINABLE AGRICULTURE IN AFRICA

The most fundamental step towards embracing sustainable agriculture concept is broadening its understanding among all players. It may not be possible to come to a common definition of sustainable agriculture, but all approaches towards promotion of sustainable agriculture will depend on the extent to which the principles are agreeable. Once the understanding has been widely propagated, it will be possible to promote this concept widely among all agricultural systems in the ways that are summarized below.

Increasing awareness on sustainable agriculture

Let more and more people get to know about sustainable agriculture. It is obvious that the division will remain but with more sensitization especially by government agencies and National Agricultural Research Systems, the misunderstanding surrounding the concept will slowly decline. It will be important for all to know that nobody needs to engage in agriculture that is not sustainable. Green explains that people get defensive when you say sustainable because they think it implies that what they have been doing is not sustainable [20]. The sensitization should take cognizance of this and make use of an approach which appreciates all contributions towards sustainable agriculture. This brings to the fore the need for measuring sustainability as discussed later on in this section.

Governments need to introduce sustainable agriculture into the mainstream agricultural extension services. It is well known that government agencies have promoted programmes that enhance sustainable agriculture such as conservation agriculture, soil and water management, food and environmental safety, push pull technologies, climate change adaptation and mitigation, sustainable markets among many others. These programmes have, however, not been promoted as key components of sustainable agriculture because sustainable agriculture has never been a goal for these agencies.

Undertake extensive research on sustainable agriculture

In all National Agricultural Research Systems, sustainability is a critical component of their work, yet sustainable agriculture is foreign to them. This is strange indeed. All research and development projects are required to have an in-built component of sustainability before they are approved but that is not about sustainable agriculture but about continuity of project activities beyond the life of the project. All technologies developed and promoted at research stations need not only be sustainable but also promote sustainability of agricultural systems in which they will be applied. Indeed research is the real meeting point between sustainable agriculture and modern

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agriculture. Research should take a lead in developing and applying measurements for sustainability. The World Bank states that Africa lacks strong indigenous research and education systems which are essential because of the agro-ecological complexity of its farming systems that undermines their ability to benefit from international technology transfers while Food and Agriculture organization of the United Nations (FAO), on calling for a paradigm shift towards sustainable agriculture stresses the need to make use of science-based evidence as opposed to mere ideologies [21].

Education and training on sustainable agriculture

Sustainable agriculture is completely lacking in mainstream education curricula in most African countries. The step forward here is mainstreaming this concept in agricultural curricula at all levels of agricultural education. Future agricultural extension will be undertaken by the learners of today. To embrace and extend sustainable agriculture, they need to learn it and grow with it. Many agricultural extension agents are now graduates who passed through a very comprehensive curriculum that never or very superficially mentioned sustainable agriculture. Such agents find it very difficult to embrace sustainable agriculture out there in the field, and perceive it as an inferior concept that did not "qualify" to be included in the university curriculum. In fact this position is widely promoted by sustainable agriculture being handled by junior certificate and diploma colleges many of which are supported by NGOs. For such graduates of the formal training, continuous training in addition to awareness as described above is necessary to change their perception.

Development and enforcement of policies to promote sustainable agriculture

Many African countries have comprehensive policies on agriculture, but with minimum or no reference to sustainable agriculture. A few policies mention sustainable agriculture and sustainability in passing. One exception is Ghana whose policy has the mission of attaining sustainable agriculture as a goal. There are, however, many strategies and thematic areas that are directly related to sustainable agriculture. Taking Kenya as an example, right from the vision 2030 to the most recent Agricultural Sector Development Strategy (ASDS) there are many components that would directly contribute to the transition towards sustainable agriculture. These thematic areas are very appropriately aligned to the overarching regional framework, that is, the Comprehensive African Agriculture Development Programme (CAADP) that on its side also has many thematic areas relevant to sustainable agriculture. The problem, however, arises from the independent approach towards these thematic areas without sufficient interrelation with one another and without an overriding goal related to sustainable agriculture. As indicated earlier, sustainable agriculture takes a systems approach and requires multidisciplinary input in the form of knowledge and expertise. Hence addressing these thematic areas whether singly or collectively is very different from doing so with an overall goal of attaining sustainability of agricultural systems. As a result, there is need for development of a comprehensive policy on sustainable agriculture or sufficient inclusion of the sustainable agriculture concept in a comprehensive agricultural policy. A good illustration of this comes from the European Union who have made investment in sustainable and inclusive agriculture and the

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development of its supportive policies at the core of their development policy [19]. Sustainable agriculture has earned a pivotal place in their internal and external policies.

In addition to policy development, the need for enforcement cannot be overemphasized. Currently, there are many policies that could support sustainable agriculture but are not being effectively implemented. For example, there are policies for protection of water catchment, environmental conservation, land ownership and management, food and nutrition among many others. Much as sustainable agriculture policies may be developed, little will be achieved without a renewed commitment to enforce them.

Measurement of sustainability

All efforts being made to promote sustainable agriculture will be fruitless if it is not possible to tell whether progress is being made or not. The input from agricultural research with regard to sustainability measurement will play a key role here. According to National Academy of Sciences, finding ways to measure progress along a sustainability trajectory is an important part of the experimentation and adaptive management process [6]. To start with, there is need for an inventory of current sustainability position and activities. Then there is need to monitor and evaluate the actions on a regular basis to tell the direction that we are taking and review our strategies from time to time. The outcome of research on sustainability measurement is eagerly awaited so that it is put into practice. Many approaches for measuring sustainability have been proposed [12, 22, 23, 24, 25, 26]. Food and Agriculture organization of the United Nations (FAO) has also developed tools for Sustainability Assessment of Food and Agriculture systems (SAFA) that are available for free to anyone wishing to use them [27, 28]. Although there may be no consensus over these approaches and they may not be practical in all circumstances, this is certainly a very important step in the right direction for sustainable agriculture. If properly functional, the measurement step will be important in informing all the other interventions on their way forward. And this step has a direct relation to awareness- creation and promotion because other people have to understand and embrace the measurements before they can be useful. For example, the Voluntary Sustainability Standards that have been developed by certain organizations have remained largely for their use without recognition or participation by government or other institutions. Because of the importance attached to this step, there is need to be careful not to make inaccurate or improper measurements. Such an error has the potential to derail the whole system and water down the efforts already achieved towards agricultural sustainability. These actions can be summarized in the Figure 3 below.

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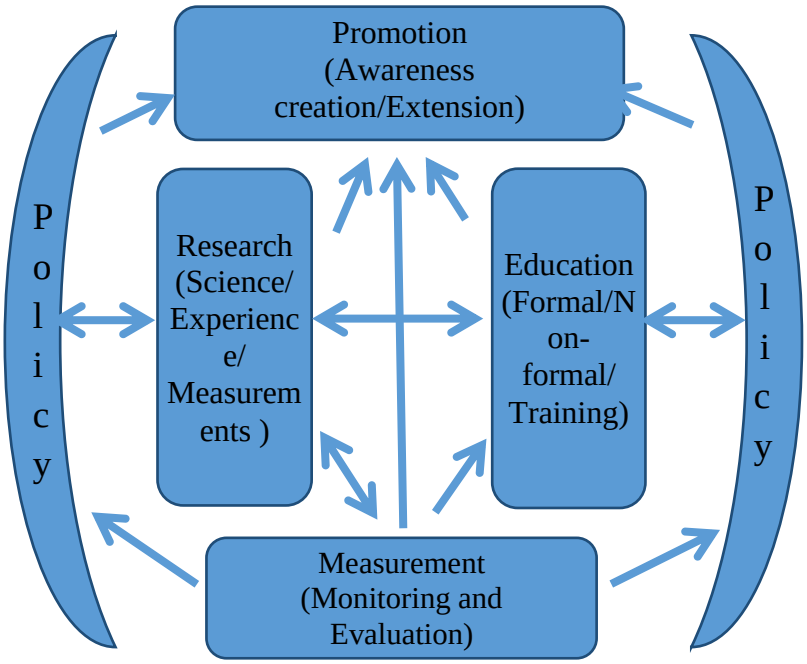

Figure 3: An illustration of the relationship between actions required to promote sustainable agriculture

In the illustration above, all the five actions are interrelated and all the four actions need to operate within and be guided by supportive policies. The policies should inform research, education and promotion while they should be developed based on information generated from research, education and measurements. Research on the other hand should provide outputs that will support education and measurements and form a basis for promotion. Education should benefit from outputs coming from research and monitoring and evaluation while serving as a key component of promotion.

CONCLUSION

Modernization of agriculture is inevitable and sustainable agriculture will determine the future of this modernized agriculture. Sustainable agriculture needs to be perceived as a concept that promotes an agricultural system that is profitable as well as socially and environmentally acceptable to all players for its continued practice. The attainment of sustainable agriculture across Africa is fundamental to the maintenance of livelihoods now and in the future. Understanding the sustainable agriculture concept is central to its promotion. Sustainable agriculture is a goal and so it may not be achieved fully. Every small step towards this goal is important to the whole agricultural system. Everyone has a role to play in this effort to attain sustainable agriculture. African governments need to play a leading role and support farmers in advancing sustainable agriculture into the future by raising awareness and promoting its understanding, supporting research in agriculture in general and on sustainability in particular, mainstreaming sustainable agriculture in academic curricula, developing policies to support sustainable

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agriculture (SA) and measuring sustainability to inform all the other strategies. To attain sustainable agriculture, all of us must work together collectively and towards a common goal. Sustainable agriculture should not be the responsibility of a few, but rather, an obligation of everyone. This obligation is now very widely resounded by the United Nations (UN) Sustainable Development Goal No 2 that calls upon everyone to promote sustainable agriculture.

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